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# U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1732

## GROWING BARLEY *for* MALT AND FEED



**B**ARLEY IS GROWN for both malt and feed. It is the purpose of this bulletin to make available to the farmer such information as may enable him to decide which variety to grow and whether or not to exercise the care necessary to obtain grain that meets the maltster's requirements.

The maltsters of the Central and Eastern States desire such barleys as Oderbrucker, Manchuria, Wisconsin Pedigree 38, Velvet, etc. They wish these barleys to be well grown, plump, mellow, carefully threshed, and free from disease and weather damage. Certain sections discussed in the bulletin are particularly adapted to the growing of these varieties and to the production of the quality desired. In the Western States varieties with larger kernels, such as Atlas, are grown. Barley of good malting quality is rarely produced except in sections where it is the major crop.

The greater part of the barley produced is certain to be fed. Barley is a very useful grain feed, and the yield per acre is high in the Northern and Western States. Many farmers should grow barley for consumption on the farm.

# GROWING BARLEY FOR MALT AND FEED

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## RECENT TRENDS AND PRESENT PROBLEMS IN BARLEY GROWING

**B**ARLEY GROWS WELL in a cool, humid climate. It will stand more heat under semiarid conditions than under humid conditions. When grown in warmer climates, it is often winter-sown. The most favorable growing conditions are found in the Northern and Western States, where it produces a high yield of grain per acre. Gradually farmers in these States have come to realize the high value of the barley crop, and there has been a slow expansion of the acreage. The average yearly production now is much greater than before the prohibition era. Any increase between 1918 and 1933 was obviously for feed. If the present trend is continued, less than one fourth of the crop will be absorbed by the maltsters. Farmers are naturally attracted by the premium for malting barley. It is a new source of revenue and a profitable one. Three fourths of the average crop, however, will not receive a premium. In favorable years barley of good malting quality is produced over wide areas, and the price is accordingly depressed. The gains in balanced husbandry should not be sacrificed in mass attempts to produce malting barley. Only those farmers who have a reasonable chance of harvesting grain of the desired quality are justified in changing from a feed to a cash crop. The farmers most likely to profit from the new market are those located on suitable lands in barley-growing sections. In such locations varieties wanted by the buyers can be grown with little or no sacrifice of yield. The local market also is built around the malting demand, and the local grain dealer is in touch with the market and equipped to serve the grower by not allowing the better barley to lose its character through mixture in the elevator or in shipment. Facilities for preventing mixture are not available in localities where little barley is grown.

In general, feed barleys should be grown by farmers who expect to use the crop primarily as feed; by farmers in sections where little barley is grown; by farmers in sections where the malting varieties yield decidedly less than the feed varieties; and by farmers in any

section where farms are of such character that good malting quality is rarely produced. The market preference for varieties is of little importance to the farmer who feeds his crop, and malting premiums are of little interest to the farmer who cannot grow malting barley.

Barley growers are at the crossroads. The growing of barley should be continued on a healthy basis free from violent shifts of acreage on account of large premiums or lack of premiums for malting barley. This can be done only by maintaining a large acreage destined for feed. The soundness and permanence of the barley acreage is dependent on the combined judgment of the individual planters.

### MALTING BARLEY

#### NORTHERN AND EASTERN STATES

Any discussion of malting barley is complicated by the great diversity of soil and climate found in the United States. The types suited to the several regions are so different and the methods of growing and

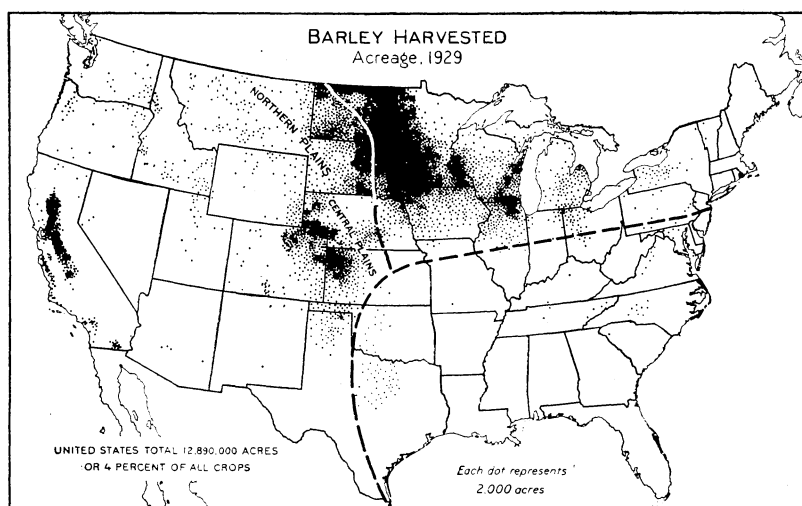


FIGURE 1.—The three general regions of barley production in the United States. The heavy broken lines divide the country into the humid-spring region (northeast), the humid-winter region (southeast), and the semiarid region (west). The dots show the acreage according to the census of 1930. Localities suitable for barley growing are indicated by the present distribution of the crop.

caring for the crop so various that the subject cannot be discussed from the standpoint of a single section. The country, however, can be divided into regions which will be discussed separately. The three most important divisions are shown in figure 1. As far as the American market is concerned, the most important region consists of the Northern States east of the Missouri River. Although many kinds of barley are grown in this region, the so-called "malting varieties" do well throughout the area, and an acceptable quality results where and when the soil and seasonal conditions are favorable. The malting market, however, is a critical one, and if the farmer wishes to be successful in this field he must be familiar with the requirements.

## WHAT THE MALTSTERS WANT

The eastern maltsters and brewers want a plump, mellow, small-kerneled barley with firm hulls not easily damaged. They wish this barley to be all of the same type, sound, carefully threshed and free from weather and disease damage. In actual field culture grain is seldom produced that is free of all objectionable features. The farmer growing barley for market should not only make every reasonable effort to enhance the quality as far as it is determined by the factors under his control, but should also be sufficiently familiar with malting requirements to be able to decide whether or not his barley meets these requirements.

Federal grades for malting barley under the Grain Standards Act have been established for barley grown east of the Rocky Mountains, effective July 2, 1934. The requirements for malting barley include the following specifications:

"This subclass shall include 6-rowed barley of the class barley (class I) which meets the requirements of grades nos. 1 to 3, inclusive, which, after the removal of dockage, contains not more than 5 percent of 2-rowed and/or other types or varieties of barley of unsuitable malting type, such as Trebi and black; which contains not more than 15 percent of barley and other matter that will pass through a 20-gage metal sieve with slotted perforations 0.076 ( $4\frac{7}{8}/_{64}$ ) of an inch wide and  $\frac{3}{4}$  of an inch long; which contains not more than 5 percent of skinned and/or broken kernels; which contains not more than 4 percent of damaged barley; and shall not include bleached barley. Barley of this subclass shall contain 75 percent or more of mellow barley kernels, which kernels are not, en masse, semisteely."

Black barleys (such as Lion) are objectionable not because they differ much from Oderbrucker, but because black kernels are sometimes difficult to distinguish from heat-damaged kernels and because the maltsters do not want them and pay less for barley when they are present.

Broken kernels are objectionable in barley intended for malting purposes because the broken kernels will not malt and must be removed to be sold as feed barley. Skinned kernels are even more objectionable than broken kernels because they cannot be screened out of barley intended for malting purposes and because they do not germinate and convert properly during the malting process. Frayed ends are objectionable. In many cases such kernels are damaged. Even if no real injury exists, malt made from barley containing many frayed ends has a poor appearance and will not sell so well as malt made from barley with unbroken hulls. Only 4 percent of damaged barley of all kinds are allowed in the malting grades. Damaged barley includes blighted, moldy, heat-damaged, sprouted, and badly weather-damaged kernels. Blighted kernels, which include those affected by scab and stripe, may be very objectionable, and the limit of tolerance cannot be much greater than the amount specified in the grades.

## LOCATION AND SOIL

Most of the barley that is malted is produced in a few States in the upper Mississippi Valley. In these States the best of the crop comes from a few localities. In the most-favored localities grain of malting quality is produced almost every year. Other sections

produce good grain in 3 years out of 4, in half the years, or only occasionally. Small areas where high-quality barley is produced are to be found in all States from western New York to South Dakota. Such areas are well known to local farmers. Obviously the growers so favorably situated now produce and probably always will produce the greater part of the market requirements.

In the barley-growing areas some farms are better suited than others for the growing of high-quality barley. The best barley soils are well-drained loams. Barley cannot stand "wet feet." For this reason, heavy, poorly drained soils do not produce good barley in regions of frequent rains. Not only is the grain likely to be coarse, but the plants are more likely to be infected with blight and scab. On the other hand, light sandy soils are poor barley soils. Growth is not maintained at a sufficiently uniform rate, and ripening is often hastened by drought.

#### VARIETIES

The choice of variety is important. No variety, however, will produce malting barley in a section not suited to barley, nor can it overcome an adverse season. The fact that a variety produces grain of fine quality in western New York should not encourage a farmer in Iowa to plant it in his fields. The State experiment stations are testing all promising sorts and are the best sources of information for local use. Full information can be had on many varieties, but some of the newer ones must be grown several years before they can be accurately appraised. The type wanted is definite. Maltsters express a decided preference for barleys of the Manchuria-Oderbrucker group and smooth-awned hybrids from these parents. Large-kerneled 6-rowed varieties and 2-rowed sorts are apparently not in demand in this area. Oderbrucker, Manchuria, Odessa, and the smooth-awned hybrids, Wisconsin Pedigree 38 and Velvet, seem to be acceptable. Manchuria, which is blue or mixed blue and white, and such blue selections of Manchuria as O.A.C. 21, are disliked by some maltsters because of the blue color, which makes the determination of mellowness more difficult. The blue color in itself is entirely harmless, being merely a pigment deposited in the outer layer of the endosperm. It has nothing to do with malting quality. The smooth-awned varieties have a tendency to peel more easily than Manchuria or Oderbrucker. This is an undesirable character. It is worse in poorly grown barley than in plump, well-matured barley. When carefully threshed, the smooth-awned sorts meet the market requirements.

#### SEED AND SEEDING

Seed should be sound, clean, and of high germination. The use of the fanning mill is important, because it removes weed seeds and many of the diseased kernels. There is a common impression that seed of high malting quality is desirable for sowing. This is true only as far as malting quality indicates strong germination and freedom from disease. Hard, flinty, steely barley is just as desirable for seeding as is the finest malting barley of the same variety if the germination is equal.

Seeding should be early for the locality. Barley does not grow well in hot, humid weather, and there is a decided advantage in early seeding.

## ROTATION

Barley of high quality is seldom produced on land that is too highly fertile. On rich lands manures are best applied to the preceding crop. The residual effect is sufficient for barley. Coarse grain and lodging are often prevented in this way. In areas where scab is serious, barley should preferably follow some other crop than corn or small grain.

## HARVESTING AND STACKING

In the harvesting of malting barley the farmer must meet a number of serious problems. Sound, fully ripened grain is without question of great importance to the maltster. On the other hand, the longer the grain stays in the field, the greater the hazards from storm and moisture damage. Ripened under the best of conditions in a humid climate, the grain assumes a bright straw color.

Quality is often seriously impaired during ripening and harvesting. The crop should stand until it is fully ripe. Not only is the grain more mellow, but the proteins cause less trouble in brewing. The proteins of growing grain are very different from those in the fully matured kernel. The same is true, in a way, with the starch. If growth is arrested by drought or too early cutting, the kernels are likely to be "steely." Such grain does not malt well and brews worse. Care should be taken not to cut the crop too soon. Probably the thumb-nail test to determine maturity is as good as any. Grain is ready to cut when it has reached the point where it will retain the imprint of the thumb nail pressed against it.

Color can easily be overemphasized. In dry areas or where the crop ripens without rain or dew, perfectly matured grain may have very little of the yellow color that is characteristic of grain ripened where light rains and dews are common. A deeper color in humid districts is not a cause for a lower price, and the farmer should not sacrifice quality to secure grain that exhibits the same brightness as that found in the drier areas.

Frequent rains at harvest time often injure the quality of the grain. Any considerable number of kernels with blackened ends lowers the market value. Musty odor is a danger signal to the barley buyer, and even a small percentage of decayed kernels may remove a shipment from the malting class. Extra care must be used in shocking and stacking barley intended for the malting market. Minimum exposure to unfavorable weather is desirable.

Stacking improves the quality of barley. Something occurs during the process of going through the sweat in the stack that makes barley more mellow and increases both the vigor and percentage of germination.

## THRESHING

Great care should be exercised in threshing malting barley. Skinned and broken kernels are a hazard to the maltster, and any chance of receiving a premium for the crop can be ruined in threshing. The maltster would prefer to have a few awn fragments remaining on the grain than to be confronted with threshing damage. Especial care may need to be taken with the smooth-awned varieties. Any thresher can adjust his machine to decrease threshing damage. Square teeth in the concaves instead of rounded ones result in fewer broken kernels in the final product. The elimination of end play in the cylinder is of great importance.



## CENTRAL PLAINS

The area discussed as suitable for the Manchuria-Oderbrucker type of barley has been very crudely bounded. "East of the Missouri", of course, does not mean that the Missouri River marks a definite boundary. Eastern Nebraska, for instance, is as much a part of the region as southern Iowa. As one goes farther west, however, conditions gradually change. The Manchuria-Oderbrucker types do not yield so much as many others do, and they shatter badly in the drier regions.

The western types come into competition with the eastern ones in northwestern Kansas and adjacent areas. The most dependable varieties in this transition area in the past have been related to those long grown on the Pacific coast. Manchuria-Oderbrucker types also can be grown, although at some sacrifice of yield. The maltsters on the eastern markets prefer this latter type, but when of good quality the larger-kerneled Coast type is also in some demand. Under such conditions the farmer has a difficult decision to make. The correctness of this decision is dependent on many factors beyond his control. Whether he has good barley depends on the season. Whether or not there will be a profitable premium for it depends on the seasonal conditions over a wide area.

## NORTHERN PLAINS

Recommendations for the dry lands of Montana and adjacent areas are equally difficult at present. The Manchuria-Oderbrucker barleys do not yield well and they shatter badly. The brewing value of Montana-grown Horn and Trebi has not been established. The quality exhibited by these varieties in other areas is little indication of what they may do here. When brewers have used barley produced in this area during 1 or 2 average years, a reasonably sound recommendation can be made. Until this information is available, none can be given.

## MOUNTAIN STATES

The agriculture of the western mountain country, like that of all mountain countries, is largely confined to the many irrigated valleys, each one a problem in itself. Regardless of variety, the grain from these valleys will always be plumper, of lower nitrogen content, and more mellow than that produced in the upper Mississippi Valley. Grain of the character obtained in the upper Mississippi Valley could not be produced even if it were desired. Furthermore, in this area, barleys of the Manchuria-Oderbrucker type shed most of their kernels before harvest. The brewing problem here, then, becomes quite different from that in Milwaukee or Chicago. If the brewer uses local material, he will probably find it good and far more uniform than that of the East, but he must of necessity develop his own methods of utilization.

Volume is, of course, limited since under highly specialized irrigation farming, the percentage of land in grain is not large and much of the barley produced is needed for feed. The scarcity of feed grains in the Mountain States and the high price paid for them often makes the importation of malt economical.

Since the better barley in the Mountain States is produced under irrigation, the judicious use of water is important. Unfortunately,

there are no rules by which the most favorable conditions can be obtained or maintained. No two fields or two seasons are alike. The object of irrigation is, of course, to keep the plants growing well, and the timing of the watering must depend on the judgment of the farmer. Wherever possible, the land should be so handled that there will be sufficient water in the soil to germinate the grain. Applications of water after seeding to start growth are usually disastrous. Too-rank growth at heading time is undesirable. Late irrigations are also a problem. There is danger of lodging the grain. On the other hand, failure of water before full maturity cuts heavily into the yield and lowers the quality. Barley kernels continue to grow until they dry. Any kernel that will not retain the imprint of the thumb nail is still growing. Thinly seeded nurse crops often produce high yields because irrigations are continued to save the grass. If possible, the last irrigation should be late enough to furnish moisture until the plant has ripened naturally. When malting barley is grown under irrigation, the threshing should be watched carefully. The dry kernels break easily, and most threshers in this region are inexperienced in adjusting their machines to meet these particular market requirements.

#### PACIFIC COAST

The conditions on the Pacific coast are peculiar to that section. Most of the market barley is raised in the interior valleys of California. The small-kerneled Manchuria-Oderbrucker barleys cannot be grown. England furnishes the market and her maltsters prefer barleys of the Coast type. Atlas is the dominant variety at present. Purity of type and freedom from threshing damage are important and are under the control of the farmer. Club Mariout is useful in late sowing and, when well grown, is used by some of the English maltsters. Its price on the English market is less than that of Atlas. The Coast type of barley was formerly produced in some quantity in eastern Oregon and Washington. There are also special areas where barleys of other types and of high quality can be grown, as in the Salinas Valley of California and the region west of the Cascades in Oregon and Washington.

#### SOUTHERN STATES

There are many local areas where barley can be grown that cannot be separately discussed. In the Southeastern States, for instance, bearded winter barley is grown that is quite similar to the Manchuria-Oderbrucker type. Conditions at harvest are often unfavorable, and over most of the South the growing of malting barley is not recommended.

#### FEED BARLEY

Feed barley is barley used as feed. It may or may not be of the varieties or qualities desired by maltsters. It may be grown solely for feed, or it may be the result of an unsuccessful attempt to grow barley acceptable to the maltsters.

Market terminology has done much to retard the expansion of the barley acreage. Grain rejected by the maltsters is called "feed barley." It usually consists of inferior grain and is only second-rate feeding material. Barley grown for feed need not be inferior grain. Indeed, in the good barley sections it is usually of relatively high quality.

In many ways it is unfortunate that feed barleys are not a crop entirely distinct from malting barleys. The value of barley for feeding must be measured by its usefulness on the farm. The return in terms of pounds of pork or gallons of milk should be the farmer's gage. The appraisal of feed barley would be much less difficult if there were no other barley market.

In the years when brewing was prohibited there was a marked increase in the barley acreage. This increase was, of course, for feed. Much of the recent shifting in barley acreage has been outside the better-known area of malting-barley production. There was a short-lived expansion into the Corn Belt. A heavy infection of scab discouraged any rapid or careless expansion in this direction. On the Great Plains there is an apparently permanent increase. This has been particularly heavy in northwestern Kansas. In western Oklahoma and adjacent areas there has been a fluctuating acreage of winter barley with an upward trend. There is also an active interest in winter barley in the Southeastern States, where the acreage for feed is increasing. Spring barley is best adapted to the Northern and Western States. Much of this area is outside the Corn Belt. A grain feed that may be substituted for corn is, of course, of great value. Barley is particularly suited to this purpose, both because of its yielding capacity and its feeding value.

On favorable soils barley yields more pounds per acre than any other small grain. It fits in well with the systems of agriculture practiced in most of the areas where the crop is adapted. It can be fed to all classes of livestock and is constantly increasing in popularity with dairy farmers. It is almost the equal of corn as a feed. As in the case of corn, it is especially prized as a feed for hogs because it produces firm pork. The value of clean and sound barley for feeding hogs depends largely upon its weight per bushel. Barley weighing 48 pounds per bushel has almost the same value as corn. If it weighs only 44 pounds per bushel, experiments indicate that it is worth about 10 percent less per bushel for hog feeding. This is due to its higher fiber content, greater bulkiness and, therefore, lower nutritive value. For other classes of livestock the higher fiber content is not such an important factor. In fattening cattle, scabby barley, which has a considerably lighter weight per bushel than sound barley, has practically the same value pound for pound as sound barley. Ordinarily, hogs will not eat scabby barley.

There is little difference in the feeding value of varieties. The farmer growing barley for feed ordinarily should use the highest-yielding variety. Other things being equal, the percentage of hull is higher on small-kerneled than on large-kerneled barleys. Feeding tests, however, have shown little difference in the value of the different kinds if they are plump and well grown.

The barley kernel is too hard to use satisfactorily as feed without some previous preparation. Grinding is the most common treatment in the Central and Eastern States. The grain should not be ground finely. Finely ground barley makes a pasty mass when chewed by animals and results in reduced consumption. When grinding barley, the machine should be so set as merely to crack the grain rather than pulverize it. In the West much of the barley is rolled. This is an ideal method of preparation. A jet of steam softens and moistens the kernel so that little loose material results. At the same time the entire kernel is flattened to a soft, easily crushed disk.

When barley is to be mixed with chicken feed the hulls are sometimes removed. This separation need not be complete. The removal of most of the hull increases the palatability for chickens and greatly improves the quality of the feed by reducing the amount of roughage.

### VARIETIES OF BARLEY

More than 5,000 varieties of barley have been tested by the United States Department of Agriculture and State experiment stations. Only a few of them are under cultivation on farms. There is a decided advantage in growing a limited number of varieties. Mixtures are a great disadvantage to the maltster, and the fewer sorts grown the less the confusion in marketing. Some of the most important varieties are briefly discussed below.

#### MANCHURIA, ODERBRUCKER, ODESSA, AND O.A.C. 21

Manchuria, Oderbrucker, Odessa, and O.A.C. 21 are similar in kernel character and are the type preferred by the maltsters of the Mississippi Valley. Although all four are grown in the Northern States east of the Missouri River, the centers of production are distinct. Odessa is largely confined to South Dakota. Oderbrucker is grown most extensively in Wisconsin, Illinois, and adjacent areas in Minnesota and Iowa. Manchuria is more common in western Minnesota and North Dakota, although a selection, Featherston, is grown to a limited extent in New York. O.A.C. 21 is extensively grown in Canada. The acreage of all these varieties has been reduced in the United States because of farm preference for the smooth-awned sorts. The grain of Oderbrucker is the whitest of the lot. Manchuria consists of a mixture of blue and white strains, whereas O.A.C. 21 is a blue strain of Manchuria.

#### TWO-ROWED

Two-rowed barleys are not grown extensively. Most brewers prefer a smaller-kerneled barley of higher diastatic power. Spartan is grown on some acreage in Michigan and nearby States. Alpha is grown in New York and Pennsylvania. There are scattering fields of Hanna and Hannchen throughout the Plains States. Horn is common in Montana, and there is a remnant of Chevalier in a few localities such as the Salinas Valley of California.

#### SMOOTH-AWNED

Farmers naturally prefer smooth-awned barleys. The Department of Agriculture and many State stations have tried to breed suitable varieties. The factor of smoothness is complex, and difficulty has been experienced in keeping such barleys uniformly smooth. Several sorts are sufficiently so for commercial purposes, and their yields have been satisfactory. Among those in common cultivation are Velvet, Glabron, and Wisconsin Pedigree 38 in the upper Mississippi Valley. Comfort is grown in Nebraska. Vaughn and Hero have attained a small acreage in California. The former variety has produced high yields in Arizona and the southern plains.

### TREBI

Sixteen years ago Trebi was released to farmers of southern Idaho. All that was known then was that it was well adapted to irrigated lands in this area. Since that date it has spread over much of the northern part of the United States and up into Canada. Although its actual field cultivation has not extended east of the Mississippi River, it has produced high yields on experiment-station plots as far east as the eastern part of Canada. The variety is unquestionably one of the most vigorous that has been tested. Despite its low resistance to disease, it has outyielded other varieties in sections to which by any other measure it seems not to be suited. The grain as produced in eastern North Dakota is very different from that of Idaho, but from the standpoint of feed, it deserves consideration. Maltsters of the Mississippi Valley do not like Trebi. Their acquaintance with the variety is limited to that grown in the northern plains and in the western half of the upper Mississippi Valley. Brewers of the Rocky Mountain area may find the Trebi grown in this area satisfactory. This is especially true of that produced under irrigation.

### COAST AND ATLAS

Coast was the common barley of the Western States for many years. The original Coast and Atlas, a selection of Coast, are still grown on most of the acreage in California. Coast is common throughout the Western States, and its near relative Stavropol is extensively grown in northwestern Kansas.

### CLUB MARIOUT

Club Mariout is limited mostly to California, where it is popular for late seeding.

### WINTER BARLEYS

Tennessee Winter and Wisconsin Winter are two of the hardest winter barleys. They are also high-yielding sorts. Both are bearded. In the Southeastern States hooded varieties are more popular than bearded varieties. The first distribution of hooded winter barleys came from the Tennessee Agricultural Experiment Station. The varieties released from this station have been added to by other southern stations and by natural hybridization occurring on farms. The hooded varieties yield less than the old bearded Tennessee Winter but are preferred by farmers because of the greater comfort in handling.

### WHERE TO PROCURE SEED

Most of the varieties recommended are already in wide cultivation. They are most reasonably secured from nearby farmers. Most States have seed-growers' associations from which certified seed can be obtained. The State experiment stations can usually furnish information as to sources. Many local seedsmen carry the more prominent varieties.

### DISEASES

Three of the most important diseases of barley for which chemical or cultural treatments are known are scab, stripe, and covered smut.

Scab is largely confined to the Corn Belt. Scab affects the quality of the grain and reduces the yield. Barley with more than a small percentage of scab cannot be used for malting. It is also unsuitable

to feed pigs, causing vomiting in extreme cases. If the grain is less heavily infected, the pigs fail to make normal gains. Scabby barley can be fed to all classes of cattle and sheep.

Treatments for scab are largely preventive. Since the disease is carried over on cornstalks and grain stubble, such material should be carefully plowed under before seeding. The disk obviously is no substitute for the plow on stubble land. Fields that were not planted to either corn or small grain the previous year are likely to be free from scab. In scab areas, the seed should be run through the fanning mill before being sown, to remove as many infected kernels as possible.

The grain should be treated with a mercury-dust compound. The only satisfactory method of application is with dusting machines, which can be purchased on the market. The machine should be rotated until every kernel is covered with a film of dust. *All mercury-dust compounds are poisonous. The operators of dusting machines should plug the nostrils with cotton and cover their mouths with moist bandages to avoid breathing the dust.*

Blighted barley is a market problem. Darkened underdeveloped kernels are caused by a wide variety of organisms in addition to that of scab. The effect of many of these are less objectionable than scab, especially for hog feeding. The buyers are often unable to determine the cause of the damage or to distinguish scabby kernels from kernels affected by other organisms. Seed treatments and clean culture reduce the amount of infection of some of these organisms.

Covered smut is the most widely distributed of the important diseases of barley. The total loss due to it is considerable. The percentage of infection varies enormously with season and region. Where covered smut is common, clean seed should be used where possible. If clean seed is not at hand, the farmer should resort to dust treatment. One of the mercury dusts is a logical choice, not only because of its usefulness in treating smut but also because of its effect on scab and stripe, where these are present. All three diseases can be controlled by a single treatment, insofar as seed treatment is effective. The mercury dusts are also effective in treating one form of loose smut. The other forms can be controlled by the hot-water treatment. Because of the serious seed injury that may result, the hot-water treatment is not recommended for use by farmers. County agricultural agents can give suggestions as to sources of chemicals and methods of treatment.

### COMMERCIAL FERTILIZERS

Most of the barley crop is grown in sections where commercial fertilizers are not widely used. Individual farmers had best secure information on fertilizers from their State experiment stations and substations.

### WHEN, WHAT, AND HOW MUCH TO SEED

The recommendations which follow as to varieties to seed and quantity and time of seeding are in accord with those of the State experiment stations as far as information is available.

**Arizona.**—In the irrigated valleys of southern Arizona tests at Mesa and Sacaton indicate that Common Six-Row and Vaughn are the most dependable varieties. Sacramento, although late, may be useful on rich soils, as it is resistant to lodging. In southern Arizona barley is seeded in the fall or winter. October

seeding is common where the crop is used for pasture. Good crops of grain can be secured from late November and December seedings. At high elevations spring barleys are sown about April 15 to May 15. The rate of seeding for winter pasture is 90 pounds per acre and for grain purposes 60 pounds per acre.

**Arkansas.**—Selection 6 (C.I.<sup>1</sup> no. 4678), a barley of the Union Winter type, has produced the highest average yield at Fayetteville. It is recommended that the seeding be done the first week in October at the rate of 7 pecks per acre.

**California.**—Atlas is recommended for the production of malting barley. Where seeding cannot be done until late, Club Mariout is suggested. Vaughn produces high yields; but because it frays considerably when threshed, it is not desired by the maltsters. The best time to seed is from late October until mid-January. A rate of 70 to 90 pounds per acre is sufficient when a drill is used. When broadcast, however, the rate is increased 25 percent.

**Colorado.**—Trebis is recommended for growing under irrigation. As a nurse crop, Colless is preferred, as it is less likely to lodge. For the dry-land districts, Club Mariout and Flynn are desirable. Under irrigation 90 pounds is a good seeding rate. The seeding date varies from the first 20 days of April around Fort Collins to the last week in April around Fort Lewis. On dry land the seeding should be done in late March or early April at the rate of 4 pecks per acre.

**Georgia.**—The most promising variety appears to be Greece. At Tifton, Tennessee Winter Selection 66 produces high yields. Hooded winter varieties have proved unsatisfactory. Barley should be seeded by early October in the northwestern part of the State and by October 25 elsewhere. The rate is 6 to 8 pecks per acre.

**Idaho.**—Trebis is recommended for growing throughout Idaho. In the Palouse section Winter Club is recommended for winter seeding. Charlottetown 80 is being distributed in cut-over areas. In irrigated sections the seeding rate is 100 pounds per acre. In nonirrigated sections the rate of 6 pecks, decreasing to 4 or 5 pecks in the drier portions, is sufficient.

**Illinois.**—Wisconsin Pedigree 38 is well adapted for general cultivation. Where stiffness of straw is essential, Spartan is recommended. Eight pecks per acre is the recommended seeding rate. On the southern edge of the barley belt early seeding is very important. Around Urbana barley should be in the ground in late February or early March. The latter half of March is the best time to seed in sections represented by DeKalb.

**Indiana.**—Only limited areas in Indiana are suited to the cultivation of barley. Wisconsin Pedigree 38 and Velvet are recommended. Spring barley should be seeded as early as possible at the rate of 2 to 2½ bushels per acre. September is the most favorable time for fall seeding.

**Iowa.**—Trebis and Spartan are recommended for feed. Velvet is recommended for market or feed. Most varieties respond to early sowing. Losses increase rapidly if sowing is delayed beyond the middle of April. Two bushels per acre is a satisfactory rate of seeding.

**Kansas.**—Stavropol is the old standard barley of western Kansas. There has been some seeding of Trebis in recent years. Vaughn and Flynn are the best of the smooth-awned varieties. Malting barleys produce fair yields but must be handled promptly to avoid shattering. It is recommended that barley be seeded during the last half of March at the rate of 1½ to 1¾ bushels per acre.

**Kentucky.**—Barley is adapted to limited localities in Kentucky. Union Winter and Tennessee Winter are the most dependable varieties. The grain should be seeded before the end of September at the rate of 2 bushels per acre. Unfortunately, barley cannot be sown late enough to avoid infestation with the Hessian fly.

**Maryland.**—Tennessee Winter and Wisconsin Winter are good barleys for fall seeding. Winter barley should be in the ground before the end of September. The best rate is 2 bushels per acre.

**Michigan.**—The 2-rowed varieties, Spartan and Alpha, are recommended. The market demand for barleys of the Oderbrucker type probably can best be met with Velvet and Wisconsin Pedigree 38. Barley should be seeded as soon as the ground can be properly prepared in the spring, at the rate of 1½ to 2 bushels per acre.

**Minnesota.**—Manchuria (C.I. no. 2330), Glabron, and Velvet are recommended for all sections of Minnesota under ordinary conditions. Trebis is recommended as a feed barley for the Red River Valley, Minsturdi for heavy soils, and Peatland for peat land. For the cut-over district in northeastern and north central Minnesota, Svansota is suggested. Barley should be seeded as early as the ground can be prepared. The recommended rate is 2 bushels per acre.

<sup>1</sup> C. I. denotes accession number of the Division of Cereal Crops and Diseases.

**Missouri.**—Trebis is recommended and should be sown in March at the rate of 2 bushels per acre.

**Montana.**—Trebis and Horn are recommended in Montana. Seeding should be done as early as the season permits and, for dry land, preferably on clean summer fallow. The rate is 8 pecks for irrigated land and from 5 to 6 pecks on dry land.

**Nebraska.**—Trebis, Glabron, Comfort, and Short Comfort are recommended. Trebis is especially popular under irrigation and for growing where the crop is harvested with a combine. Barley is usually sown at the rate of 2 to 2½ bushels per acre in eastern Nebraska, the rate diminishing materially toward the west under upland conditions.

**New Jersey.**—Alpha and Velvet are suggested for growing in all sections of the State. The usual rate of seeding is 10 pecks, although for late seeding 12 pecks is probably a better rate. The best date of seeding varies from April 1 in the southern to April 15 in the northern part of the State.

**New Mexico.**—In southern New Mexico barley may be either fall sown (Sept. 15 to Oct. 15) or spring sown (Feb. 1 to 15). When fall sown, the unnamed variety C.I. no. 4673 produced the highest average yield at State College. It is recommended that both fall and spring barleys be seeded at the rate of 90 to 100 pounds per acre. In northern New Mexico spring varieties are grown. They should be sown in late May or early June at the rate of 1 bushel per acre.

**New York.**—Alpha (two-rowed) and Featherston No. 7 (six-rowed) are considered useful varieties for the farmer to grow. They should be sown in April at the rate of 2 bushels per acre.

**North Carolina.**—The farmers of North Carolina prefer the hooded varieties even though they yield less than the bearded Tennessee Winter. Rowan and Tennessee Beardless No. 6 are recommended. They should be sown in October at the rate of 2 bushels per acre.

**North Dakota.**—Trebis is recommended as a feed barley for most of North Dakota. Manchuria and Velvet are satisfactory market varieties. In eastern North Dakota Manchuria and Velvet should be sown at the rate of 6 pecks per acre. Five pecks are sufficient farther west. For Trebis and other large-seeded varieties, the rate should be higher. The seed should be sown in late April or early May.

**Ohio.**—Glabron and Velvet are recommended for spring seeding. Most of the barley acreage is in northwestern Ohio. They should be sown at the rate of 2 bushels per acre the first week in April or as soon after that as possible.

**Oklahoma.**—The winter barleys of Oklahoma have become more or less adapted to the country, and it is recommended that seed be secured locally. Of the smooth-awned sorts, Vaughn has shown some promise. Fall-sown barley should be in the ground by October 15. Spring varieties should be sown between February 10 and March 10. Two bushels per acre is a desirable rate for fall seeding. For spring seeding the rate varies from 5 pecks per acre in western Oklahoma to 8 pecks on the better lands where the rainfall is heavier.

**Oregon.**—Trebis is recommended for spring seeding and Winter Club (Utah Winter) for fall seeding in the Pendleton area. Flynn fits best into agricultural practices around Moro, although other varieties may produce equal yields. Around Pendleton the seeding should be done between March 1 and 15. On the drier lands seeding should be done as early in the spring as soil conditions permit. Rates of seeding vary in eastern Oregon, being as high as 2¼ bushels in the regions of greater rainfall and less in the drier areas. In western Oregon O.A.C. no. 7 is recommended for fall seeding, for early spring seeding, and for sowing on bottom land. Its selections, no. 1 and no. 6, are more winter-hardy and are more desirable for fall seeding. Hannchen is the best barley for medium and late spring seeding, especially on upland. In western Oregon barley should be sown from October 10 to 30 for fall seeding and April 1 to 30 for spring seeding.

**Pennsylvania.**—Wisconsin Pedigree 5, Comfort, and Velvet are satisfactory varieties for Pennsylvania. The average date of seeding in the vicinity of State College is about April 24. In southeastern Pennsylvania the most favorable time is about 2 weeks earlier and in the northern counties about 2 weeks later. Two bushels per acre is the usual rate of seeding.

**South Carolina.**—Beardless and Tennessee Winter are the varieties usually recommended. The latter is superior for pasture and winter grazing where the residue is to be turned under. October is the most favorable month for seeding, and 1½ to 2 bushels per acre is the best seeding rate.

**South Dakota.**—Odessa is recommended for the eastern part of the State, and Horn, Ace, and Lion × Manchuria for the central area. Trebis should be grown under irrigation in the western portion. Barley should be sown early. Sowings made later than April 15 are likely to produce reduced yields. It is recommended



that 6 pecks per acre be sown in the eastern part of the State, and 5 pecks in the central and western sections except under irrigation, where 8 pecks should be used.

**Tennessee.**—Union Winter has long been a standard variety in Tennessee. Many farmers, however, prefer the hooded sorts, Tennessee Beardless 5 and Tennessee Beardless 6. Barley should be sown the latter part of September or in early October. Eight pecks per acre is the usual rate.

**Texas.**—Finley or strains of Tennessee Winter are recommended for northeastern Texas, and Vaughn for sections to the west. Winter seeding from November to January is recommended for the San Antonio section. In north Texas winter barley should be sown from October 1 to 20, and spring barley about February 1. Spring barley is preferred in western Texas. In the Panhandle most of the barley is sown about February 15. Winter barley is grown to some extent along the Oklahoma border but frequently winterkills in the Panhandle. The rate of 2 bushels per acre is suggested for northeastern Texas, while 6 pecks is sufficient for most of the areas to the west.

**Utah.**—Trebi is recommended for the irrigated lands of Utah. It should be seeded in April at the rate of 2 bushels per acre. In the Nephi area, Bulgarian, a winter variety, is the best of many tried. It should be sown in September at the rate of 7 pecks per acre.

**Virginia.**—Wisconsin Winter and Esaw are recommended for seeding on farms in the Potomac area. Tennessee Winter, likewise, has some market qualities that make it desirable, and it is a logical selection where a kernel similar to Manchuria is desired. Barley should be seeded before the end of September, the best rate being 2 bushels per acre.

**Washington.**—The leading spring varieties are Beldi Giant, Trebi, and Blue. Winter Club has long been recognized as the most dependable winter variety and is recommended for fall seeding. Barley should be sown as early in the spring as conditions permit. On the drier lands of the Big Bend country, sowing should be done in March or early April. In the better-watered parts of the Palouse, April is the most satisfactory time for spring sowing and the latter part of September for fall sowing. Rates of seeding vary from 5 pecks on the drier soils to 8 pecks on the best of the Palouse.

**West Virginia.**—The 2-rowed variety, Alpha, has proved to be superior to the 6-rowed sorts in West Virginia. Seeding should be done early in April. About 7 pecks is a desirable rate for Alpha, although 6 pecks is ordinarily sufficient for the 6-rowed varieties.

**Wisconsin.**—Wisconsin Pedigree 38 is recommended. It is usually sown immediately after the seeding of wheat and oats is completed. This varies from April 1 to May 7, but the average date is about the third week in April. The common rate is 2 bushels per acre, but 1½ bushels is recommended for Wisconsin Pedigree 38.

**Wyoming.**—Coast and Trebi are recommended for dry land. Where the straw is to be utilized Horn, Smyrna, and Vaughn are suggested. For irrigated conditions Horn and Trebi are satisfactory. Five pecks per acre is the recommended seeding rate on dry land and 8 pecks on irrigated land. The best time to seed is from April 15 to May 1.